MASTER OF SCIENCE
IN
METEOROLOGY AND PHYSICAL OCEANOGRAPHY

EROSION IN SOUTHERN MONTEREY BAY

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The coastal cliff top line recession has historically been used to calculate erosion along the Southern Monterey Bay. Digital photogrammetry is used in this work to produce Digital Terrain Models (DTM), representing the coastal cliff top line of 1984. This links the historical recession data sets with the light detection and ranging (LIDAR) measurements of 1997 and 1998 and a 2003 cliff top line measured using Kinematic DGPS. Recession time series starting in the 1940's are produced for several locations. Least square linear fits of the recession data are computed for the periods 1940-84, 1940-98 and 1940-03. At Fort Ord and Sand City the resulting slopes show a persistent erosion trend of ~1meter/year, unchanged in the last 19 years. The mean sea level (MSL) evolution is studied using historical San Francisco MSL data because of its high correlation with Monterey MSL. Higher MSL during El Niño years, coincident with higher erosion rates, show the correlation between erosion and MSL. In the long term, high-erosion El Niño years combine with normal years averaging to a near constant erosion trend. For Phillips Petroleum and Beach Lab, a significant decrease in the erosion rate is observed after sand mining stopped in Sand City.

Digital photogrammetry provides a high-quality representation of the shoreline topography, offering useful information to the warfighter in terms of detailed beach or landing zone characterizations.

KEYWORDS: Coastal Erosion, Photogrammetry, El Niño, Southern Monterey Bay

FACTORS INFLUENCING THE STRUCTURE OF THE MONTEREY BAY SEA BREEZE

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The sea breeze is a thermally induced circulation that arises along essentially every coastline. However, the Monterey Bay circulation associated with the sea breeze varies day to day because of the influence of features such as inversions, clouds, synoptic-scale flow, and topography. Understanding the sea breeze is important because it impacts fire weather, air pollution, agriculture, and aviation operations, among other things. Analyses are conducted using a multi-quadric based program to investigate the Monterey Bay sea breeze during 01-31 August 2003. This program incorporates aircraft data, surface observations, and profiler data. Outputs from the analysis program are plotted in VISUAL to characterize the structure of the sea breeze. Factors including inversions, cloud cover, amount of heating, distribution of heating, synoptic-scale flow, and topography are studied to determine their influence on the sea breeze. Six days that best illustrate the factors that influence the structure of the Monterey Bay sea breeze are presented in this thesis. Results show that offshore flow weakened the strength of the sea breeze and decreased the depth, as expected. A cooling trend in surface temperatures at the end of the month also weakened the strength of the sea breezes and decreased the depth. Clouds are present during this period, which influenced the amount of heating, and consequently, the sea breeze response. The presence of a marine layer weakened the thermal gradient that in turn, weakened the sea breeze circulation.

KEYWORDS: Sea Breeze, Monterey Bay, Synoptic-scale Flow, Inversion, Thermal Gradient, Cloud Cover, Complex Terrain

MODELING OPTICAL TURBULENCE WITH COAMPS DURING TWO OBSERVATION PERIODS AT VANDENBERG AIR FORCE BASE

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The objective of this thesis is to investigate the forecastability of optical turbulence using the U.S. Navy's Coupled Ocean Atmosphere Mesoscale Prediction System (COAMPS). First, a detailed synoptic study was performed over the Eastern Pacific region for observation periods in October 2001 and March 2002 to focus on mesoscale features affecting Vandenberg AFB. Second, a modified version of COAMPS version 2.0.16 model output was evaluated to ensure reasonable modeling of the mesoscale. Next, temperature and dewpoint temperature vertical profiles of COAMPS, modified with the Turbulent Kinetic Energy (TKE) Method, were initially compared with balloon-launched rawinsondes, then with higher resolution thermosondes. Optical turbulence parameters were then calculated from the data and a comparison between synthetic profiles and thermosonde-derived profiles were qualitatively and quantitatively studied. Then the vertical resolution of the model was increased for selected forecasts to determine the potential for forecast improvement.

KEYWORDS: Atmospheric Modeling, COAMPS, Modeling, Numerical Modeling, Optical Turbulence, Optics, TKE Method, TKE-Free Method, Turbulence, Turbulent Kinetic Energy